Barometrically Enhanced Remediation Technology (BERT™)

Technology Need:

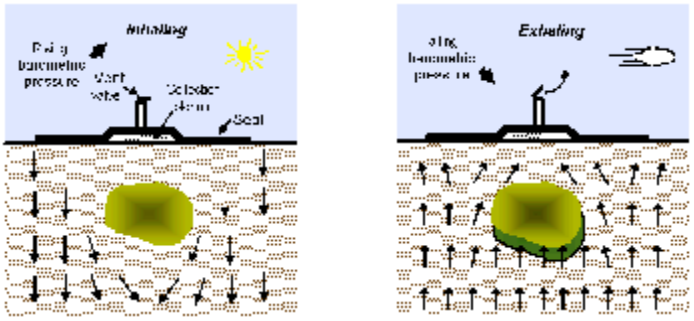
The majority of the planned remediation sites within the Department of Energy (DOE) complex are contaminated with volatile organic compounds (VOCs). In many instances, the contamination has not reached the water table so it does not pose an immediate threat, particularly at sites with distances to the water table of hundreds of feet. Yet these sites will ultimately require remediation of some type, either by active vapor extraction, in situ thermal treatment, bioremediation, or excavation and ex situ soil treatment, at costs ranging from $50K to well more than $150K. In addition, many remediated sites sustain residual contamination because current in situ techniques are typically not 100% effective. These circumstances result in modest contamination of limited risk, which must still be controlled.

Technology Description:

Science & Engineering Associates, Inc. (SEA) has developed a low-cost, simple in situ containment and extraction methodology for sites where the contamination resides in the vadose zone soil. The approach capitalizes on the vertical soil-gas movement resulting from natural barometric pressure oscillations, and harnesses this mechanism to ensure a net vertical upward soil-gas flux in the contaminated soil. The design is notable in that it requires no boreholes or site power, resulting in a low-cost, low-maintenance remediation system. This technology is applicable to sites where the contamination is volatile under standard conditions, resides close to the soil surface and above the water table, and the water table is not shallow.

Oscillations in barometric pressure are both diurnal, corresponding to daily heating and cooling of the atmosphere, and of longer time periods, resulting from the passage of weather fronts. Daily variations will average about 4 to 5 millibars (one millibar, mbar, is approximately one thousandth of an atmosphere) while those due to weather front passage can be 25 mbar or more. As the barometric pressure rises, a gradient is imposed on the soil gas, which drives fresh surface air into the soil. As it drops, gas vents upward from the soil into the atmosphere. The total movement of soil gas is dependent primarily on the magnitude and period of the pressure oscillations, the soil gas permeability, and the depth to an impermeable boundary. This boundary can be the water table, bedrock, or extensive layers of very low permeability material, such as caliche or clay. Since the fractional change in atmospheric pressure is small (typically 0.5 percent) the overall soil gas displacement during the daily cycle is also small (with an estimated range of centimeters to meters).

The Barometrically Enhanced Remediation Technology (BERT™) induces net upward displacement of soil gas using surface features that impede the downward movement of vapors, but allow upward movement. The system incorporates a surface seal, a plenum, and an extraction vent valve. Directly above the contaminant plume a layer of highly permeable material, such as pea gravel, is placed on the surface to form a collection



The surface treatment system controls the movement of soil gas due to barometric pressure changes.

plenum for the upward-moving soil gas. An impermeable membrane is placed over the collection plenum and extends outward over the soil surface to form a buffer zone, which controls the radial movement of air flowing into the soil during the high-pressure periods. The plenum is connected to the atmosphere with a stack that incorporates a high-volume vent valve, open only when soil gas is moving upward (during a drop in the barometric pressure). In operation the system ratchets the soil gas upward by allowing normal upward flow during barometric lows but restricts downward airflow during high-pressure cycles. The stack also allows the system to capitalize upon wind to create pressure gradients, significantly enhancing the contaminant removal efficiency.

Benefits:

<The system prevents soil vapor flow down to the water table by ensuring a net upward movement of soil gas in the contaminated soil.

<No boreholes are required for the remediation/containment process.

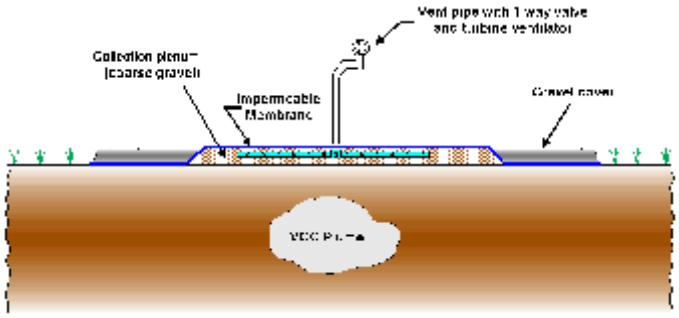
<The vented air is of sufficiently low VOC concentration that, with respect to most state regulations, it can be released to the air without off-gas treatment.

<The design is very low cost since it does not require boreholes, excavation, site power, or an active off-gas treatment system.

<The system requires no site power and virtually no hazardous waste is generated.

Status and Accomplishments:

This passive soil venting technology has been demonstrated and deployed at the Idaho National Engineering and Environmental Laboratory (INEEL) Radioactive Waste Management Complex (RWMC) BERT™ was demonstrated from December 1998 through March 1999. Following the successful demonstration at the RWMC, BERT™ has been deployed to passively



Typical field installation of BERT™ barometric pumping remediation system.

remediate the organic contamination in the vadose zone at Operable Unit 7.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 2307
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For more information, please visit SEA's website at http://www.seabase.com/

An Innovative Technology Summary Report (ITSR) for the BERT™ technology is available at http://ost.em.doe.gov/ifd/scfa/itsrs/itsr2307/itsr2307.pdf